KamLAND 4π Control System

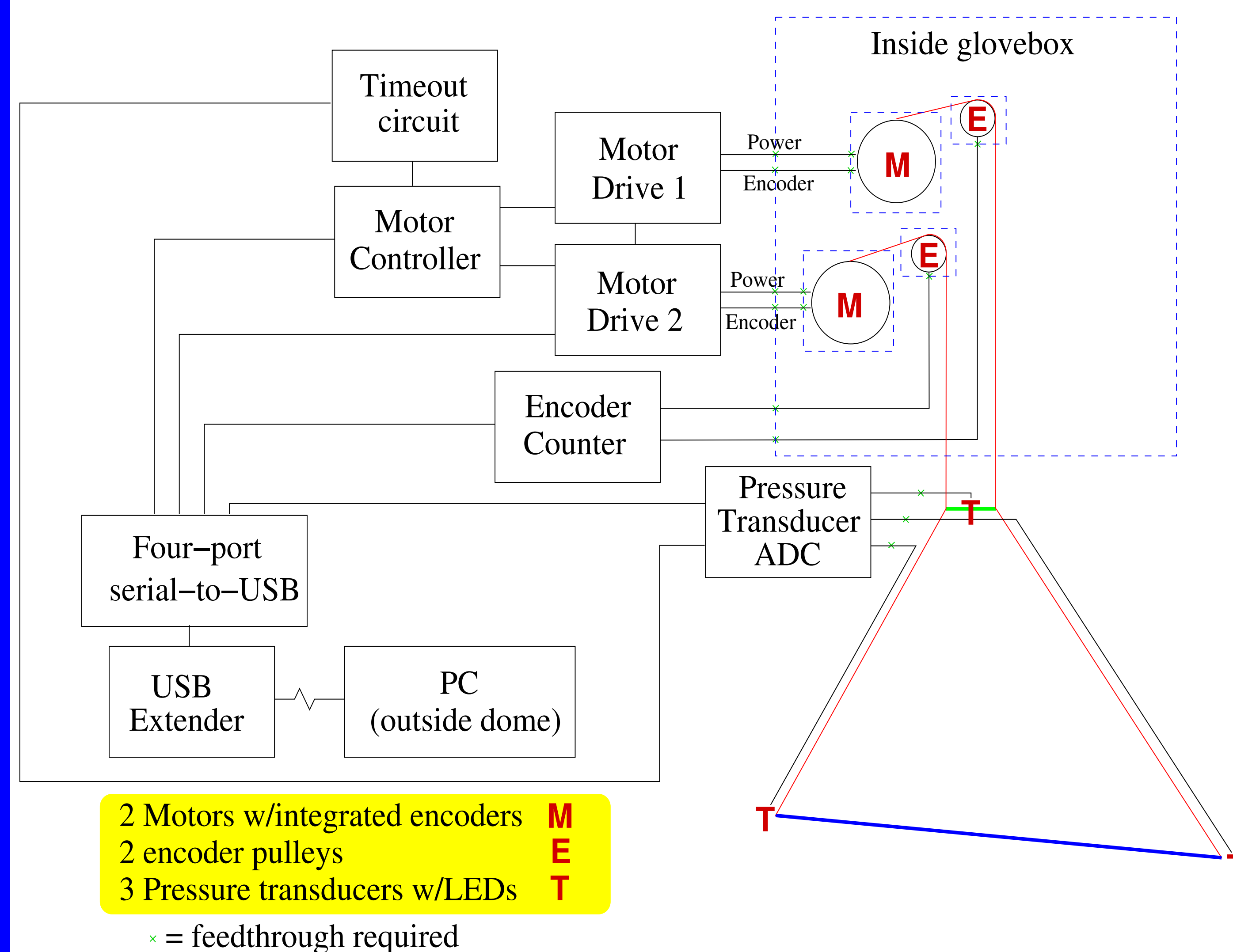## University of California, Berkeley and Lawrence Berkeley National Laboratory

Multiple layers of protection

...against mistakes that might damage the detector:

1. Written deployment protocol.
2. Operator – required to move in small steps.
3. Pre-verification of commanded motion.
4. Continuous cross-checks between various position measurements.
5. Immediate stop if measured position goes outside allowed region.
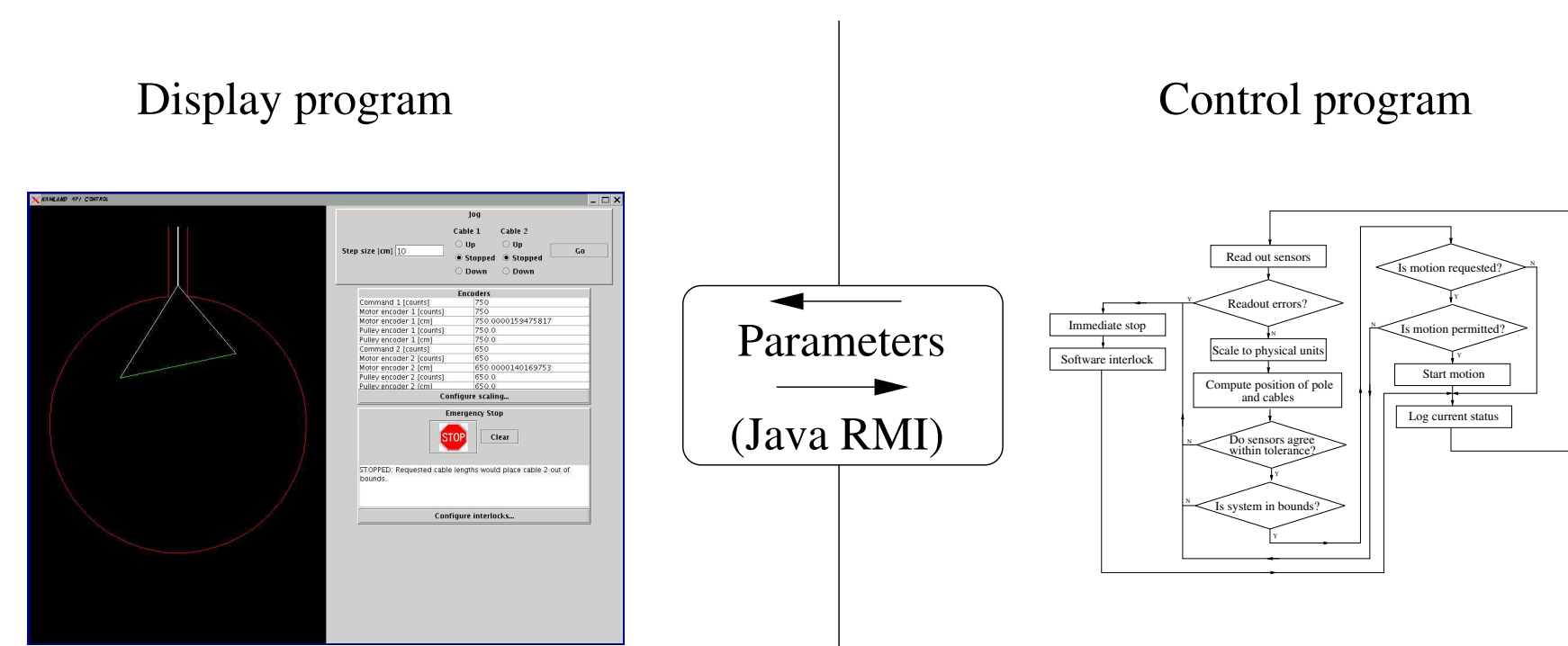
Hardware inventory

- Motors: Compumotor SM232AE servos (6.6 lb-in continuous torque, 1000 line integrated encoder)
- Drives: Compumotor Gemini GV-U2E
- Controller: Compumotor 6K4
- Encoders: US Digital S1-1024 (1024 line)
- Encoder counter/display: US Digital ED2
- Four-port serial-USB: Keyspan USA-49WLC
- USB extender: Lindy 42801 (uses category 5 Ethernet cable)
- Timeout circuit: custom (J. Meyer) – interlocks controller if computer monitoring stops

Inside glovebox

Timeout circuit — Motor Controller — Motor Drive 1 — Motor Drive 2 — Encoder Counter — Pressure Transducer ADC — Four-port serial-to-USB — USB Extender — PC (outside dome)

2 Motors w/integrated encoders **M**
2 encoder pulleys **E**
3 Pressure transducers w/LEDs **T**

× = feedthrough required

Control software

Display software is more complex and failure-prone, so it is separated from the control software:

Display program

Control program

Parameters

(Java RMI)

(Over)simplified flowchart

Read out sensors
Readout errors?
Immediate stop
Software interlock
Scale to physical units
Compute position of pole and cables
Do sensors agree within tolerance?
Is system in bounds?
Is motion requested?
Is motion permitted?
Start motion
Log current status